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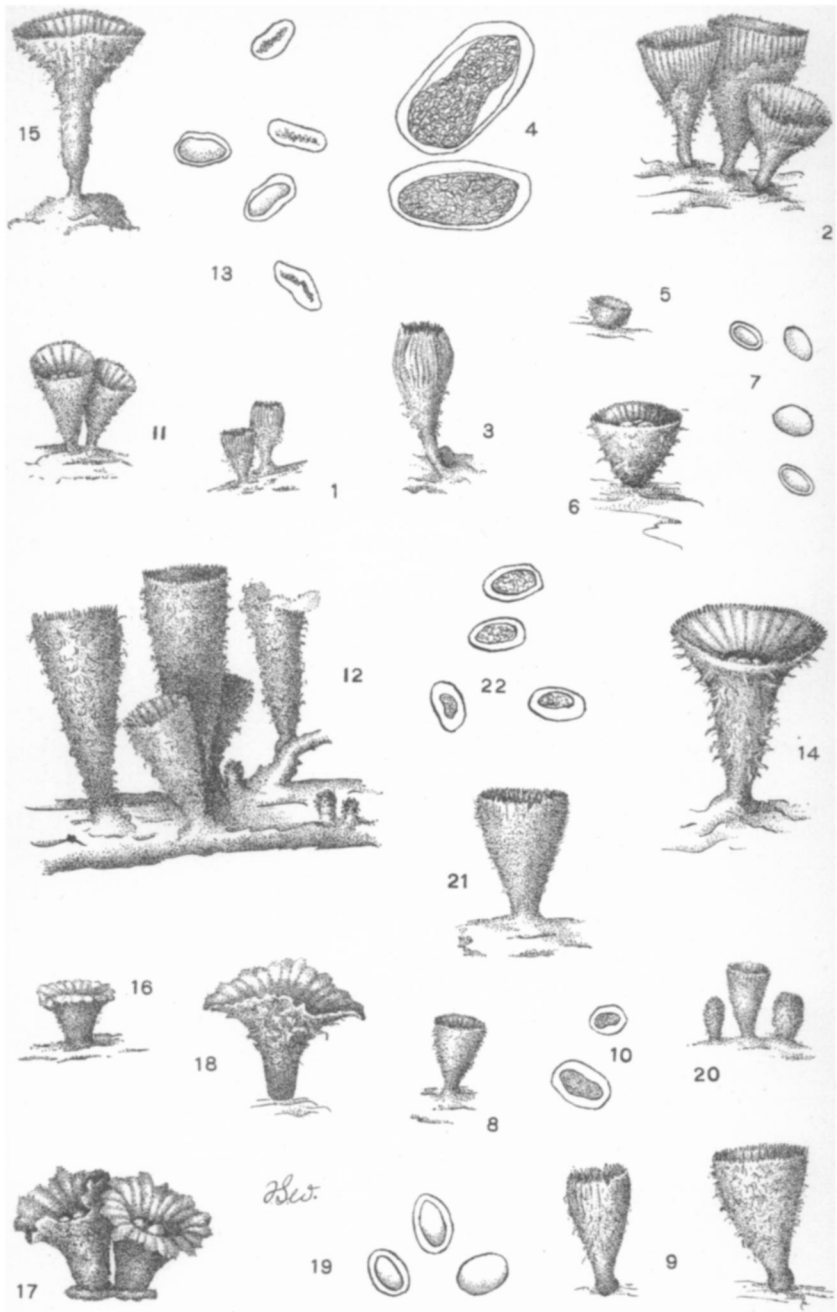
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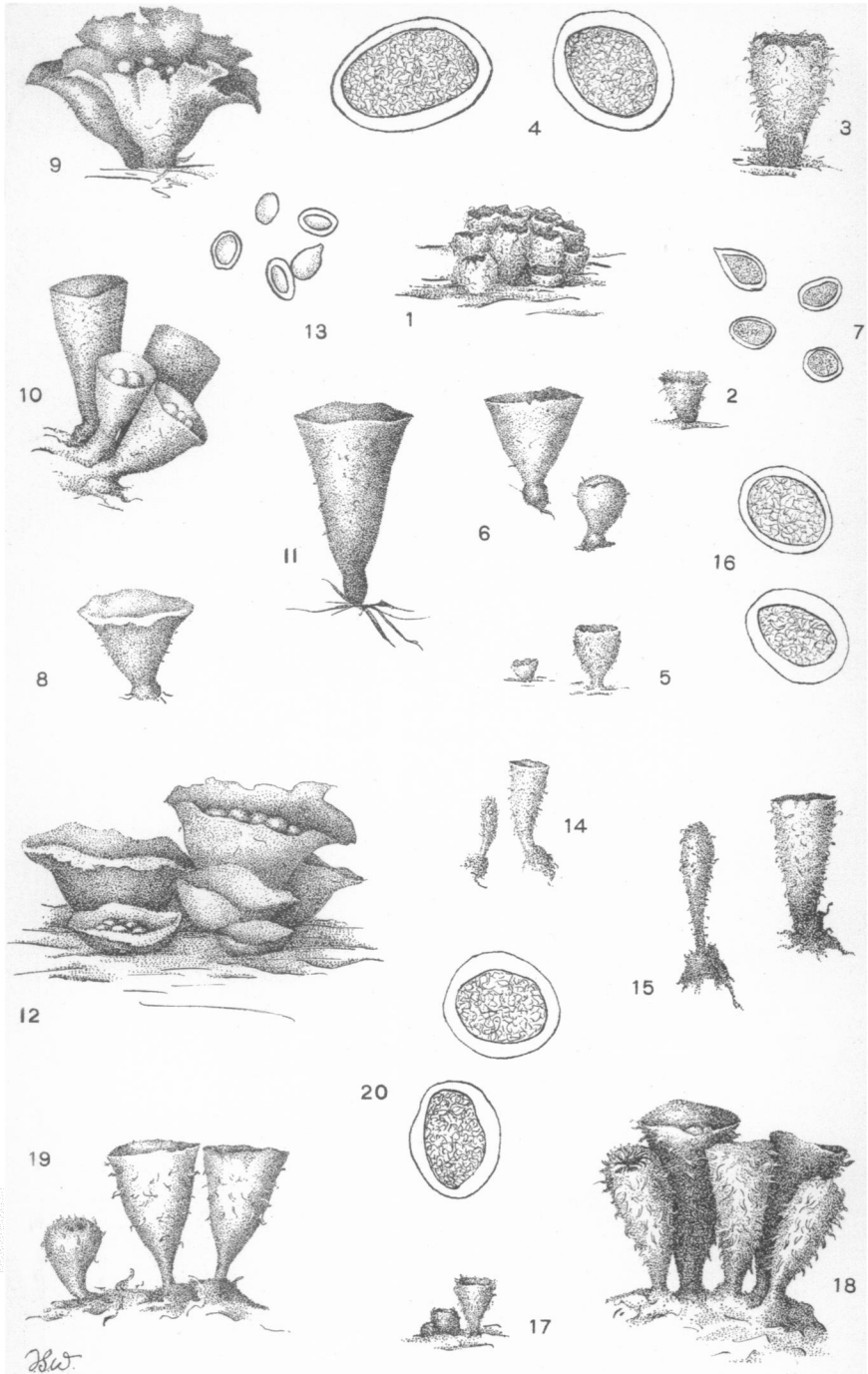
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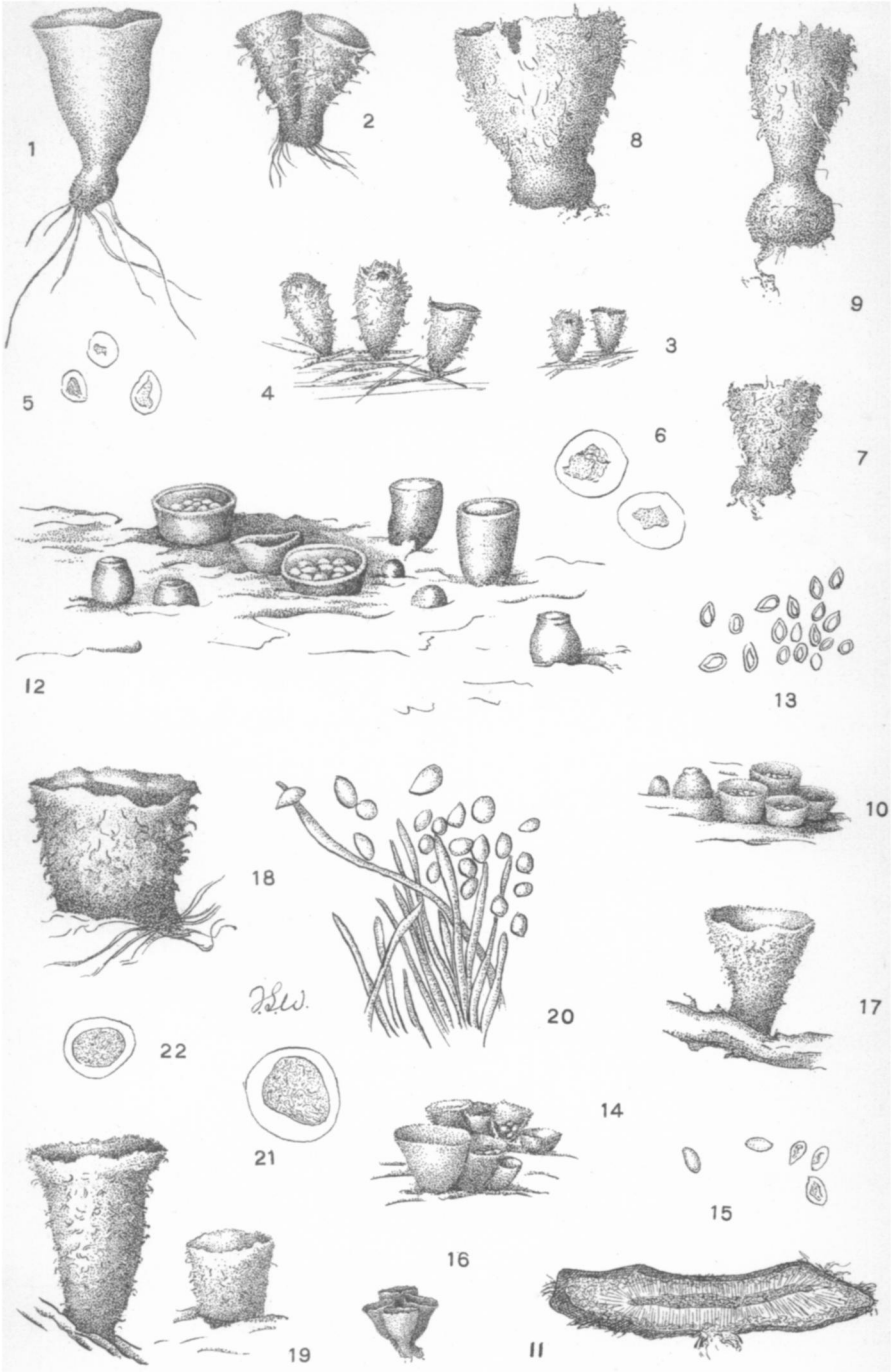
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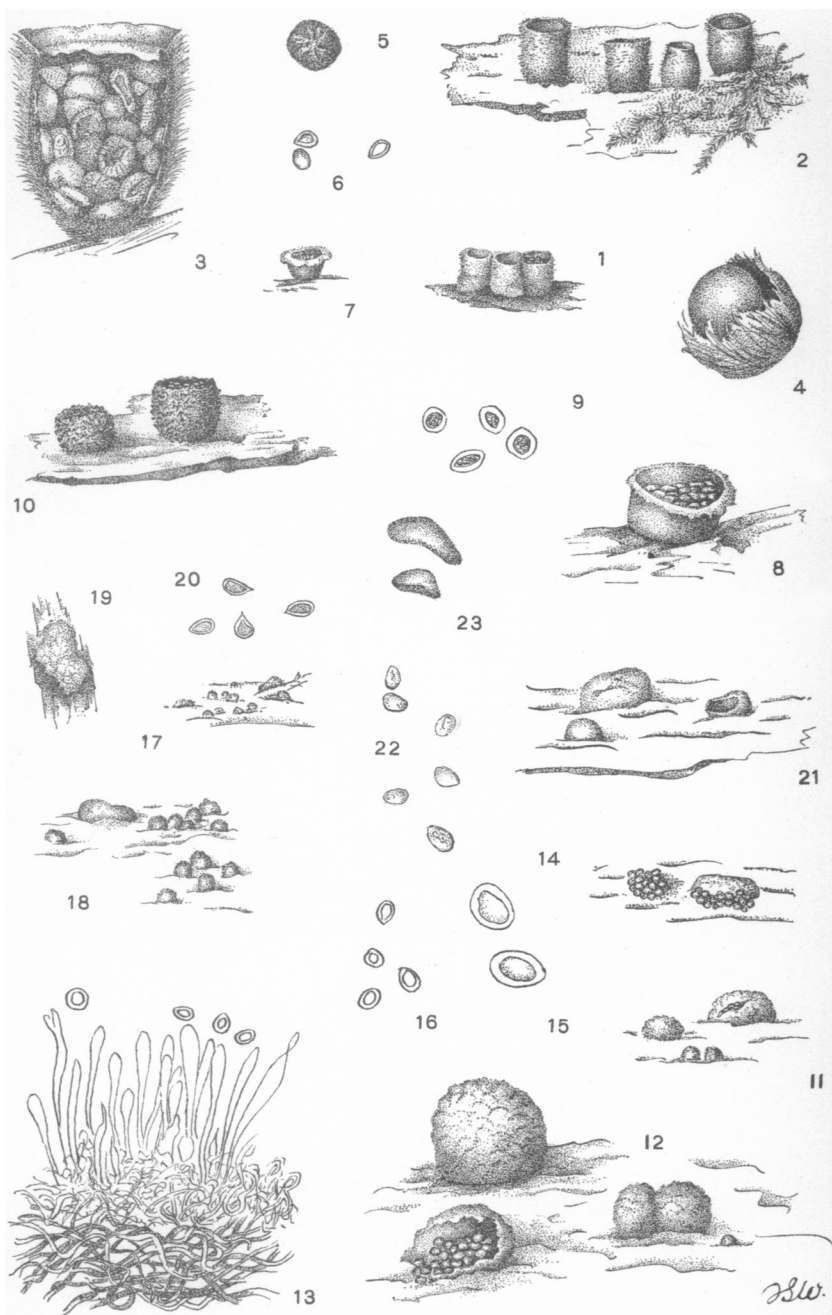
CYATHUS.



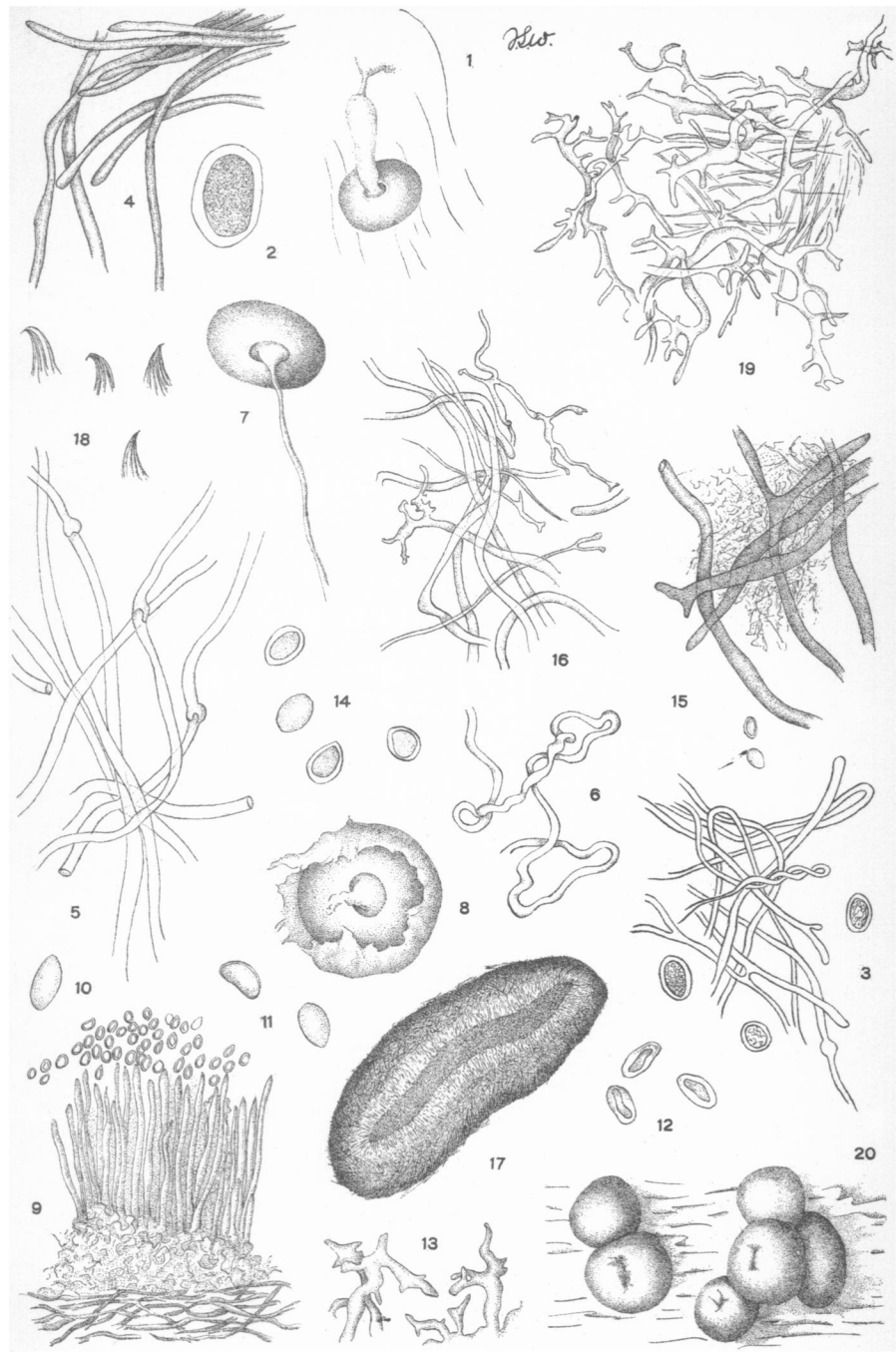
CYATHUS.



CYATHUS, CRUCIBULUM, NIDULA.



NIDULA, GRANULARIA.



NIDULARIACEAE.

BULLETIN
OF THE
TORREY BOTANICAL CLUB

MAY 1902

The Nidulariaceae of North America*

BY V. S. WHITE

(WITH PLATES 14-18)

The members of the family Nidulariaceae are small fungi, seldom attaining a height of 15 mm., the average height being from 5-7 mm. The ripe sporophores are usually more or less regularly cup-shaped, containing from 10-20, or in some species, more, lenticular seed-like bodies, which are analogous to the chambers of the gleba in the other chief groups of the gastromycetes; these bodies are usually known as sporangioles or peridiola, while the cup is known as the peridium.

They are widely distributed, as will be shown in the following pages, and several of the species are fairly common, appearing principally in wet weather, in late summer and autumn, often per-

* This revision of the family was made possible by the large amount of material found at the New York Botanical Garden, principally forming part of the Ellis collection, and by additional material furnished by Professor L. M. Underwood, from his own private collection. Professor F. S. Earle and Professor C. H. Peck also kindly loaned specimens. Thanks are due to Professor G. F. Atkinson, of Cornell University, for the loan of three drawings of *Nidularia Alabamensis* made by Mr. H. Hasselbring, and for a specimen of this same species; to Professor Farlow, of Harvard University, for kindly allowing specimens of *Cyathus pallidus* Berk. & Curt. and *Cyathus Wrightii* Berk., to be examined and sketched; to Mr. Stewardson Brown, of the Philadelphia Academy of Science, for his courtesy in facilitating the examination of Schweinitz's specimens nos. 2211-2220; to Miss Anna Murray Vail, Librarian of the New York Botanical Garden, for help in tracing references; to Mr. E. S. Salmon, for looking up some data at Kew, England, and most especially to Professor L. M. Underwood, under whose direction the work was undertaken.

sisting through the winter months. They grow on manure, sticks, shavings, dried herbaceous plants, and *Crucibulum crucibuliforme* is frequently found on old pieces of sacking. On a certain old board walk at Lakewood, N. J., this last species was found by the hundred growing in regular series between the joints of the boards. A further study of the plants will probably show that they are far more common and widely distributed than is at present thought, for they are likely to escape detection owing to their small size and inconspicuous coloring.

The order Nidulariales comprises but one family, the Nidulariaceae. Until quite recently this family was considered by De Toni* and others to include the genera *Cyathus*, *Crucibulum*, *Nidularia*, *Thelebolus*, *Dacryobolus*, *Sphaerobolus*, *Polyangium* and *Atractobolus*, the last two included as doubtful genera. Fries† included besides the three first mentioned genera, *Arachnion* Schwein. *Myriococcum* Fries, and *Polyangium* Link. The two latter genera are certainly out of place here, *Myriococcum* belonging under the Perisporiales,‡ and *Polyangium* is not mentioned by either Saccardo or Fischer. In Fischer's revision of the family in 1899, he places *Arachnion* Schwein.§ under "Doubtful Genera" in the Sclerodermataceae; for *Sphaerobolus* Tode he establishes a separate family; *Thelebolus* is placed under the Ascobolaceae, and *Dacryobolus* and *Atractobolus* are included in the same family but as doubtful genera.

This leaves only the three genera, *Cyathus* (for which there is an earlier form of the name, *Cyathia*) *Crucibulum*, and *Nidularia*, in this family. Concerning the last genus a question already raised by Otto Kuntze presents itself in regard to the correct name, since Roth's *Granularia*|| antedates Fries and Nordholm's *Nidularia*¶ by over a quarter of a century. Roth's description and figure of *Granularia pisiformis* place this genus on a certain footing, and there can be no hesitation in answering the above question. Recently some

* Saccardo, Syll. Fung. 7 : 28. 1887.

† Syst. Myc. 2 : 296. 1822.

‡ Saccardo, Syll. Fung. 1 : 29. 1882.

§ Engler & Prantl, Nat. Pflanzenzenfam. 1^{1**} : 339. 1899.

|| Ust. Ann. Bot. 1 : 6. pl. 1. f. 1. 1791.

¶ Syn. Gast. 2. 1817-18.

plants resembling *Crucibulum* in habit * have been described under *Nidularia* which differ so much in the peridial structure and character from the type of the genus, with the exception of not having the sporangioles attached to the inner wall of the peridium, that it seems best to establish another genus in order to simplify as much as possible the arrangement of the family. It was ardently desired to retain the name *Nidularia*, but unfortunately it has been found impossible to do this as all seven of the species which Fries † gives under his section *Nidularia* conform to the type of *Granularia*, so the name *Nidularia* must pass into synonymy.

It is interesting to note that Corda ‡ included only *Nidularia* and *Cyathus* under the Nidulariaceae. Nees noted a resemblance between this family and *Polysaccum*, but the latter genus is included by Fischer § under the Sclerodermataceae as *Pisolithus* Alb. & Schwein.

Although the members of this family have been mentioned in nearly all works treating of fungi from the time of Clusius, 1601, little was known of their structure and life habits until 1842, when Schmitz || wrote a short paper on *Cyathus*, and two years later the brothers Tulasne, ¶ instigated by this first effort to continue the study of these interesting plants, prepared their treatise on the organization and fructification of the Nidulariaceae, which, with the supplementary work of Sachs, ** Eidam †† and Brefeld, ‡‡ forms the foundation of our exact knowledge of this group of fungi.

The American species have never been monographed, and even the mention of plants belonging to this family has been comparatively infrequent.

* Under *Crucibulum* De Bary (Comp. Morph. 321) calls attention to the fact that he was unable to find a funiculus in some peridioles but says "the coil always showed a small point which answers to it." In the specimens referred to this genus there was absolutely no trace or rudiment and it would be impossible even in young sporangioles to determine to which side they had been attached.

† Anleit. 103. 1842.

‡ Syst. Myc. 2 : 300. 1823.

§ L. c. 338.

|| Ueber *Cyathus*. Linnaea, 16 : 141. pl. 6, 7. 1842.

¶ Ann. Sci. Nat. III. 1 : 41-107. pl. 1844.

** Bot. Zeitung, 833-845, 849-861. 1855.

†† Cohn's Beitr. z. Biol. 2 : 221-245. 1876.

‡‡ Bot. Mitt. über Schimmelpilze, 3 : 176-180. 1877.

For a long time the Nidulariaceae seemed to be a bone of contention among various botanical writers, in the fact of their apparently differing from other fungi in having true and visible seeds.* In 1688 Camerarius published a dissertation "de Fungo calyciformi seminifero," setting forth his ideas on the subject and claiming that these fungi had seeds. Marsigli in 1713, on the contrary, tried to exclude what he calls "these simple plants" from the fungi, no fungi having true seeds as these plants seemed to have. In 1714 Tournefort was also inclined to exclude them from the fungi, but Ant. de Jussieu in 1728, denied these propositions, and claimed emphatically that fungi have seeds like true plants. Forty years later fungi were still being classed outside of the vegetable kingdom, particularly so because the sporangioles of *Cyathus* were never seen to germinate. Necker in 1783 wanted to make an intermediate kingdom to consist of the fungi, and Pico five years later, said that he had absolutely proved that the nature of these productions was purely animal. In 1791, Bulliard incontestibly proved that all fungi have seed, but he called the sporangioles of *Cyathus* seeds, and added "that they seem somewhat out of proportion to the size of the fungus." Hoffman says "potius capsula seminalis quam semen ipsum"—"they are less seeds than capsules filled with seeds," while Micheli said that the spores are hard to see with a good magnifying glass.

These fungi have had several popular names, probably owing to their quaint and attractive appearance. Besides the well-known name of "bird's-nest fungi," as far back as 1724 they have been "called in Worcestershire cornbells, where they grow plentifully,"† and in Lincolnshire "we find that a kind of fungus like a cup or old-fashioned purse with small objects inside is called a 'fairy purse' and we presume that the small objects represent the fairies' cash."‡

Synopsis of the Genera of the Nidulariaceae

Sporangioles attached to the inner wall of the peridium.

Peridium composed of three layers; spores mixed with filaments. I. CYATHIA.

* Most of what follows in this paragraph is translated and adapted from Tulasne's monograph, pages 54-56, as several of the works referred to were unfortunately unobtainable.

† Ray, Syn. Ed. 3, 2: 20. 1724.

‡ Friend, Flower Lore, 34. 1889.

Peridium composed of one homogeneous layer ; spores not mixed with filaments.

II. CRUCIBULUM.

Sporangioles not attached to the inner wall of the peridium.

Peridium thick, opening by a regular definite mouth. III. NIDULA.

Peridium thin, rupturing irregularly. IV. GRANULARIA.

I. CYATHIA P. Br., Civ. and Nat. Hist. Jamaica, 78. 1756

Cyathus Hall. Stirp. Helvet. 3: 127. 1768

Peridium composed of three distinct but closely connected layers. Mouth at first closed by a membrane (epiphragm), usually white, opening at maturity ; sporangioles flattened, umbilicate beneath, attached to the inner wall of the peridium by a complex elastic cord (funiculus), and with thick horny filaments intermixed with the spores.

Clusius,* in 1601, made the first mention of a *Cyathia* under the name of fungus minimus *ανώνυμος*, and described it in Latin, the following being a free translation of the entire paragraph : " Moreover this fungus, which I will call anonymous, is very different from the preceding ones, and I consider it to be the smallest of all, for it is barely half an inch high. In the fall a great many grow, without petiole, on wooden boards away from dust and sand. They have the color of cinders or are of a lifeless color. The shape, which is so small, appears to be undeveloped, scarcely as large and as thick as the top of a little finger. Sometimes they grow alone or when in numbers two, three or four adhering together, and when ripe, they throw off the top part and appear full of a viscous juice, and of seeds which are about the size of the seeds of cyclamen, but have the outline of small fungi and are apparently cinder-colored. There is no doubt that this fungus grows in Italy, for I remember that a friend of mine sent me, once upon a time from there, some of these seeds, dried and with a certain strange name, asking me if I could find out what they were. For there are certain characters who endeavor to catch and buy praise from the ignorance of others."

There seem to be no intermediate references to this plant until 1671, when Bauhin † mentioned " Fungus minimus lignelis tabellis areolarum hortorum adnascens." Mentzel, ‡ in 1682 first figured

* Rar. Plant. Hist. cclxxxvii. 1601.

† Pinax, Lib. X., Sec. 5, no. 39, 374. 1671.

‡ Ind. Nom. Plant. Univ. pl. 6. 1682.

a plant which was, without doubt, *Cyathia lentifera*. Loeselius,* and Marsilius,† made passing references to this same species, and in 1729 Micheli‡ described and figured two species, citing one from the above-mentioned writers, and the second from Ray,§ Dillenius|| and Vaillant,¶ the latter species being unquestionably *Cyathia striata*. Linnaeus,** in 1753, gives under his section "Acaules" of the genus *Peziza*—*Peziza campanulata lentifera*, first referring to Hortus Cliffortianus (1737) where we find that the only species of *Peziza* which he gives, and to which he refers what is evidently a *Cyathia* is not a *Peziza* in the modern sense, but the first known type of *Cyathia*; and the only proof that he knew what a *Peziza* really was, is his reference to Dillenius'†† work published in 1719, in which a true *Peziza* is figured. Dillenius divided the *Pezizae* into two sections: (1) *Membranacei et tenuiores*—the true *Pezizae*, and (2) *Duriores calyciformes, seminferi putati*, under which head he gives *Peziza calyciformis lentifera laevis* (our *Cyathia lentifera*) and *Peziza calyciformis lentifera hirsuta*" (our *Cyathia hirsuta*).

The genus *Cyathus* was founded in 1768 by Haller, twelve years after *Cyathia* P. Br., and since that time many species have been described from nearly all parts of the world. Fischer‡‡ states that there are forty-two known species.

From our own country not many species have been described, Schweinitz was the first to mention these plants; in 1818 he named ten species, but not all of them are to be referred to the genus *Cyathia*. In 1869 Berkeley & Curtis§§ described *Cyathus pallidus* from Cuba, also reporting *Cyathus intermedius*, *Cyathus Montagnei*, *Cyathus limbatus*, *Cyathus Poeppigii*, *Cyathus microsporus*, and *Cyathus Lesueurii* collected by Wright from the same island. Berkeley,||| in 1873, described from Connecticut, *Cyathus Wrightii*,

* Flor. Prus. 98. 1703.

† Dissert. Gen. Fung. 17. pl. a. 1714.

‡ Nov. Plant. Gen. 222. pl. 102. f. 1, 2. 1729.

§ Syn. 3: 21. 1704.

|| Giss. 196. 1719.

¶ Bot. Paris. 57. pl. 11. f. 4, 5. 1727.

** Sp. Pl. 2: 1180. 1753.

†† L. c.

‡‡ Engler & Prantl, Nat. Pflanzenfam. 11*: 328. 1899.

§§ Jour. Linn. Soc. 10: 346. 1869.

||| Grevillea, 2: 34. 1873.

which has not since been reported. *Cyathus rufipes* was described in 1897 by Ellis & Everhart* from Kansas, and the next year Hennings, † described *Cyathus niveotomentosus* from California.

The following summary will show the distribution of the known species of *Cyathia*:

EUROPE, 7 species: *C. complanata*, *C. deformis*, *C. fimetaria*, *C. hirsuta*, *C. lentifera*, *C. subiculosa*, *C. umbrina*.

ASIA, 6 species: *C. emodensis*, *C. Hookeri*, *C. intermedia*, *C. minima*, *C. Montagnei*, *C. sulcata*.

AFRICA, 5 species: *C. affinis*, *C. dasypus*, *C. pallida*, *C. hirsuta*, *C. lentifera*.

AUSTRALIA, 9 species: *C. Baileyi*, *C. desertorum*, *C. fimicola*, *C. intermedia*, *C. stercorea*, *C. Montagnei*, *C. pezizoides*, *C. pusio*, *C. lentifera*.

NEW ZEALAND, 3 species: *C. Colensoi*, *C. Novae-Zelandiae*, *C. similis*.

NORTH AMERICA, 11 species: *C. intermedia*, *C. lentifera*, *C. melanosperma*, *C. Berkleyana*, *C. rugisperma*, *C. rufipes*, *C. hirsuta*, *C. stercorea*, *C. pallida*, *C. Wrightii*, *C. fragilis*.

CUBA, 7 species: *C. intermedia*, *C. Montagnei*, *C. pallida*, *C. limbata*, *C. Poeppigii*, *C. Berkleyana*, *C. stercorea*.

SOUTH AMERICA, 12 species: *C. ambigua*, *C. dasypus*, *C. limbata*, *C. microspora*, *C. Montagnei*, *C. plicata*, *C. Poeppigii*, *C. Puiggarii*, *C. scutellaris*, *C. hirsuta*, *C. lentifera*, *C. Gayana*.

Synopsis of the Species of *Cyathia*

Peridium sulcate-striate within.

Spores large, more than 35μ long.

1. *C. Poeppigii*.

Spores small, less than 8μ long.

2. *C. Berkleyana*.

Spores of medium size, $12-20\mu$ long.

Peridium sparingly clothed with short fasciculate hairs without.

3. *C. intermedia*.

Peridium thin, shaggy-tomentose without.

4. *C. hirsuta*.

Peridium very tough and brittle, rough tomentose.

5. *C. dura*.

Peridium faintly striate near the mouth, not sulcate within.

6. *C. Montagnei*.

Peridium smooth within, not sulcate.

Spores large, more than 40μ long.

7. *C. melanosperma*.

Spores small, less than 15μ long.

Sporangioles darkish; margin of peridium straight.

Peridium smooth or nearly so.

8. *C. pallida*.

Peridium strigose-tomentose.

9. *C. rugisperma*.

Sporangioles light colored; margin of peridium often recurved.

10. *C. lentifera*.

Spores of medium size, $15-30\mu$ long.

Peridium with a red felt-like mycelial bulb at base.

11. *C. rufipes*.

Peridium with a thick bulb of whitish mycelium.

12. *C. Wrightii*.

Peridium scarcely thickened at the base.

13. *C. stercorea*.

‡ Bull. Torrey Club, 24: 125. 1897.

† Hedwigia, 37: 274. 1898.

1. *Cyathia Poeppigii* (Tul.)

Cyathus Poeppigii Tul. Ann. Sci. Nat. III. 1: 77. pl. 4. f. 23-25; pl. 5. f. 3-4. 1844.

Peridia slender, goblet-shaped, 7-12 mm. high, 5-7 mm. wide at the top, about 1 mm. at the base of the stem, dark chocolate-brown, the outer surface somewhat shaggy, peeling, leaving a comparatively smooth, deeply and closely striated surface, corresponding with the deep inner striations, the inner surface brown, somewhat lighter colored than the outer surface, somewhat shiny, deeply striate; mouth minutely fimbriate; sporangioles blackish, flattened, dull, 2-2.5 mm. in diameter; funiculus long; spores 38-45 μ long, 18-22 μ in diameter, very thick-walled, granular within, oblong and often slightly curved. (Pl. 14. f. 1-4.)

Growing singly and in groups on manure and wet ground.

ST. CROIX (Danish West Indies): *A. E. Ricksecker*.

This species was originally described from Cuba and French Guiana; it is easily distinguished from the other striated species of *Cyathia* by its unusually large spores, and by its deeply and closely striated outer surface.

2. *Cyathia Berkleyana* (Tul.)

Cyathus microsporus β *Berkleyanus* Tul. Ann. Sci. Nat. III. 1: 74. 1844.

Peridia small, cup-shaped, 5-8 mm. high, 5-7 mm. wide at the top, very much narrowed and rounded at the base, brownish outside and somewhat shaggy; mouth finely fimbriate, the inner surface of the peridium shiny, grayish-brown, lighter colored than the outer, coarsely striate; sporangioles small, 2 mm. in diameter, shiny, nearly black, flattened; spores small, 6-8 μ long, 4-6 μ wide, somewhat thick-walled, hyaline. (Pl. 14, f. 5-7.)

On decayed stems of coarse herbaceous plants.

JAMAICA: *Cockerell*.

This species was originally described from Brazil; it somewhat resembles small specimens of *Cyathia hirsuta*, but it differs from that species in the texture of the outer coat, which is much less shaggy and thick, and in the much smaller spores.

3. *Cyathia intermedia* (Mont.)

Nidularia intermedia Mont.; Sagra, Hist. Phy. Pol. Cuba, 321. 1838-42.

Cyathus intermedius (Mont.) Tul. Ann. Sci. Nat. III. 1: 72. *pl.* 4. *f.* 4-7. 1844.

Peridia cup-shaped, not rounded at the base, 7-9 mm. high, 6-8 mm. wide at the top, 1-2 mm. at the base, lightish brown, clothed with fine hairs which grow in clusters, the tips of several of which join together in little outwardly curved tufts, thin and showing the inner sulcate markings through in the older peridia; inner surface brown, shiny, sulcate-striate; the mouth straight, not flaring, clothed with a circle of short stiff bristles; the sporangioles about 2 mm. in diameter, flattened, blackish, depressed beneath, somewhat angular with a short attachment; spores hyaline, 12-18 μ long, 6-9 μ wide, thick-walled. (*Pl.* 14. *f.* 8-10; *pl.* 18. *f.* 18.)

Growing in loose soil and on decaying wood.

[CUBA: *Ramon de la Sagra*.]

DELAWARE: Faulkland, *Commons*.

This species was originally described from Cuba; it differs from *Cyathia hirsuta* in the character of the tomentose outer covering of the peridium, and in the shorter and more rudimentary attachment of the sporangioles to the inner peridial wall.

4. *Cyathia hirsuta* (Schaeff.)

Peziza lentifera β Linn. Sp. Pl. 2: 1180. 1753.

Peziza sessilis campanulata villosa Scop. Fl. Carn. 57. 1760.

Peziza prima Schaeff. Fung. Bav. et Palat. Icon. 2: *pl.* 178. 1763.

Cyathus hirsutus intus striatus Hall. Stirp. Helvet. 3: 127. 1768.

Peziza cyathiformis Scop. *p. p.** Fl. Carn. 2: 486. 1772. [Ed. 2.]

Peziza hirsuta Schaeff. Fung. Bav. et Palat. 4: 124. 1774.

Peziza striata Huds. Flor. Ang. 634. 1778. [Ed. 2.]

Peziza hirsuta Batsch, Elench. Fung. 127. 1783.

Nidularia striata With. Bot. Arrang. 3: 446. 1792 [Ed. 2]; Sibth. Fl. Ox. 393. 1794; Fries. Syst. Mycol. 3: 298. 1822; Schwein. Trans. Amer. Phil. Soc. 4: 252. 1834.

Cyathus striatus Willd. Fl. Berol. 399. 1787; Hoffm. Veg. Crypt. fasc. 2: 33. *pl.* 8. *f.* 3. 1790; Pers. Syn. Meth. Fung. 237. 1801; Nees, Syst. 140. 1817; DC. Fl. Fr. 2: 269. 1805; Tul. Ann. Sci. Nat. III. 1: 67. 1844.

* As the first cited reference under the description of this species belongs to *C. lentifera* this name cannot be taken up for this species.

Peridia 10–15 mm. high, 8–10 mm. wide at the top, 2–4 mm. at the base, usually straight trumpet-shaped, very gradually spreading toward the top; outer surface of the peridium dark brown, shaggy fibrillose; inner surface brown or grayish-brown, shiny, striate-sulcate for about one half the height of the peridium, becoming smooth at the base; mouth densely clothed with a circle of stiff regular bristles; sporangioles darkish, 2 mm. in diameter, shiny, depressed beneath, and somewhat angular from the pressure of one upon the other; spores 12–18 μ long, 6–9 μ wide, thick-walled, hyaline, somewhat crescent-shaped. (*Pl. 14. f. 11–14; pl. 18. f. 1–6.*)

Growing singly and in clusters, on sticks, bark, etc.

EXSICC.: Ellis, *North American Fungi*, 729.

NEW YORK: *Underwood*, *Tooke*, *Clinton*, *Brown*, *Murrill*; MAINE: *Harvey*; CONNECTICUT: *White*; PENNSYLVANIA: *Gentry*, *Lloyd*; OHIO: *Lloyd*, *James*; GEORGIA: *Underwood*; ALABAMA: *Earle*; IOWA: *Langlois*; WISCONSIN: *Williams*; INDIANA: *Underwood*; MONTANA: *Anderson*, no. 601; COLORADO: *Bethel*; WASHINGTON: *Suksdorf*; CANADA: *Dearness*; PUERTO RICO: *Underwood & Griggs*; MEXICO: *Egeling*.

Tulasne* has given an account of the development of this species from which the following is freely translated:

The young plants arise on the thick felt-like mycelium in the shape of small cylindrical jelly-like masses. They are at first white and smooth, gradually changing to a brown color and their surface becomes somewhat scaly. The three coats which compose the peridium are indicated at this stage, when the outer brownish scaly portion begins to form itself into the outer coat, while the walls of the white glutinous inner substance become differentiated from the fruiting portion into a very thin membrane which encloses these parts, a thin portion of the glutinous membrane remaining between these two coats welding them together and so forming the triple peridial wall. It is now that the sporangioles begin their growth, gradually absorbing the surrounding substance into themselves, so that when the plant is mature and gradually opens, the sporangioles alone remain within the cup attached to the sides of the peridium by means of a funiculus of a complicated structure. The sporangioles are in most

* Ann. Sci. Nat. III. 1: 50–54. *pl. 3*; *pl. 4. f. 1–3*; *pl. 8. f. 1–12*. 1844.

cases composed of three parts, namely, of a thick and usually dark colored coat, a light hyaline thickly interwoven portion which bears the basidia, which in their turn bear the spores. The center part is composed of innumerable spores mixed with branching filaments. The walls of the spores are very thick, these spores having long been separated from their basidia. The funiculus is composed of three parts; the lower portion is variable as to length and thickness, its lower extremity is expanded and attached to the peridium; the upper portion is more regular in shape and is attached by its upper extremity to the sporangiole; it is rather swollen in the center, in which portion there is enclosed a long and slender filet composed of innumerable hyaline, interwoven filaments, which can be drawn out if great care is used in the process and forcibly distended without breaking, according to Tulasne to a length of 12 cm. These two parts are joined by a much narrower and shorter portion to which Tulasne gives the name of "filet médian."

4a. *CYATHIA HIRSUTA* **infundibuliformis** var. nov.

Peridia 1.5–18 cm. high, funnel-shaped, 1–2 cm. wide at the top, 1.5–2 mm. at the base, 4–5 mm. in the center where the peridium is contracted; outer surface of the peridium brownish, coarsely shaggy-tomentose; inner surface dull brownish, clearly striate, but not below the contraction; mouth minutely fimbriated; sporangioles dull brownish, 2 mm. in diameter, flattened; spores 8–12 μ wide, 14–17 μ long, thick-walled, hyaline. (*Pl. 14. f. 15.*)

Growing singly on leaves and moss.

MONTANA: Sheridan, *Fitch*.

This variety differs from the type in the definite funnel-shape of the peridium, and in the nature of the tomentum, and to a less degree in the size of the spores. Further material may necessitate a different treatment.

5. *Cyathia dura* sp. nov.

Peridia flaring trumpet-shaped, 8–13 mm. high, 8–12 mm. wide at the top, 2–4 mm. at the base, brownish-gray outside, rough, shaggy, and very tough and brittle; inner surface whitish, dull, and marked with rather wide shallow striations; mouth recurved, ragged and much split, but not fimbriate; bases of the peridium contracted and in some specimens there is a thick felty

brown mycelial band adhering; sporangioles dull grayish, oval or rounded, 2.5 mm. long, 1.5 mm. wide; spores 14–18 μ long, 8–10 μ wide, hyaline and thick-walled. (*Pl. 14. f. 16–19.*)

COLORADO: Denver, *Bethel*, 8.

This species differs from all others seen in the character of the peridium, which is very thick, hard and brittle.

6. *Cyathia Montagnei* (Tul.)

Cyathus Montagnei Tul. Ann. Sci. Nat. III. 1: 70. *pl. 4, f. 9–11.* 1844.

Peridia 8–10 mm. high, 6–9 mm. wide at the top, 2–3 mm. at the base, spreading, cup-shaped, reddish-brown outside, closely woolly-tomentose, but not shaggy, rather thin; inner surface grayish, dull, faintly striate close to the top, not sulcate; mouth at first curved inwards, then straight, but not recurved, closely and very minutely fimbriate; sporangioles 2 mm. in diameter, grayish, black, somewhat lighter beneath, dull, flattened, angular; spores 15–18 μ long, 8–12 μ wide, thick-walled, granular, hyaline. (*Pl. 14. f. 20–22.*)

On the ground and on decaying wood and chips.

YUCATAN: *C. F. Millsbaugh*, 787; [CUBA].

This species was originally described from Brazil; it is readily distinguished from the preceding species: (1) By the faint and only partial striae of the upper part of the inner surface of the peridium, and (2) By the woolly tomentose, and not shaggy nature of the outer coat.

7. *Cyathia melanosperma* (Schwein.)

Nidularia melanosperma Schwein. Trans. Am. Phil. Soc. 4: 253. 1834.

Cyathus melanospermus (Schwein.) De Toni; Saccardo, Syll. Fung. 7: 42. 1887.

Peridia cup-shaped, clustered, 5–7 mm. high, 5–6 mm. wide at the top; the outer surface brownish and very shaggy; the inner surface smooth, shiny, dark gray; mouth straight and slightly fimbriate; sporangioles black, flattened, about 2 mm. wide; spores large, 45–55 μ long, 18–45 μ wide, very thick-walled, granular within, hyaline. (*Pl. 15. f. 1–4.*)

Gregarious on the earth.

PENNSYLVANIA: Bethlehem, *Schweinitz*.

The above description is based on Schweinitz's original speci-

mens, which are still in good condition at the Philadelphia Academy of Sciences. This appears to be a rare species, as it is known only from its original collection. It differs from all the following species of *Cyathia*, which have a smooth inner surface, in having a fimbriate mouth, though Schweinitz in his original description notes that it has a smooth mouth, but he writes that *Nidularia stercorea* has a fimbriate mouth, which is contradicted by his own specimens.

8. *Cyathia pallida* (B. & C.)

Cyathus pallidus B. & C. Jour. Linn. Soc. 10 : 346. 1869.

Peridia 4–8 mm. high, 5–7 mm. wide at the top, about 2 mm. at the base, slender urn-shaped, slightly expanded at the top and contracted at the base, thin and membranous, fawn-colored outside, and minutely shaggy; inner surface light lead-colored, smooth, shiny; mouth entire or torn but not fimbriate, sometimes slightly striated; sporangioles 2 mm. in diameter, flattened, the edges very thin, and thicker in the middle, darker above than below, shiny as if frosted, and under high magnification showing a network of delicate rugose wrinkles; spores 5–9 μ long, 5–7 μ wide, hyaline, thick-walled, oval-pointed or nearly round, pale yellow in the mass. (*Pl. 15. f. 5–7.*)

Growing on decayed wood.

CUBA : *Wright*; PUERTO RICO : Coamo Springs, *Underwood & Griggs*.

The above description is based on the co-types of this species in the Curtis collection at Harvard University.

9. *Cyathia rugisperma* (Schwein.)

Nidularia rugisperma Schwein. Trans. Am. Phil. Soc. 4 : 253. 1834.

Cyathus rugispermus (Schwein.) De Toni; Saccardo, Syll. Fung. 7 : 42. 1888.

Peridia somewhat obconic, sharply contracted at the base, 5–8 mm. high, 4 mm. wide at the top; outer surface lightish fawn-colored, strigose-tomentose, becoming nearly smooth when mature; inner surface darkish brown, smooth, and shiny; mouth incurved in the young peridia, and completely covered by the tomentose outer covering; sporangioles black, flattened, roundish, 1–1.5 mm. in diameter; spores 10–14 μ long, 8–10 μ wide, somewhat granular and thick-walled, hyaline. (*Pl. 16. f. 3–6.*)

Growing singly on bits of shaving and fibrous matter.

PENNSYLVANIA : Bethlehem, *Schweinitz*.

The above description is based on the original specimens. Schweinitz, in his description of this species, says: "Sporangii non nitentibus, sed superficie reticulato-rugosa," but no such markings were noticeable.

This is a pretty little species, and is known only from its original collection.

10. *Cyathia lentifera* (L.)

Peziza lentifera a Linn. Sp. Pl. 2: 1180. 1753.

Peziza sessilis campanulata laevis Scop. Fl. Carn. 57. 1760.

Peziza tertia Schaeff. Fung. Bav. et Palat. Icon. 2: pl. 180. 1763.

Cyathus sericeus intus laevis Hall. Stirp. Helvet. 3: 127. 1768.

Peziza cyathiformis Scop. p. p. Fl. Carn. 2: 486. 1772 [Ed. 2].

Peziza sericea Schaeff. Fung. Bav. et Palat. 4: 125. 1774.

Peziza lentifera Huds. Fl. Ang. 2: 633. 1778 [Ed. 2].

Peziza Olla Batsch, Elench. Fung. 127. 1783.

Nidularia vernicosa Bull. Champ. 1: 164. pl. 488. f. 1. 1791.

Cyathus laevis Hoffm. Veg. Crypt. fasc. 2: 31. pl. 8. f. 2. 1792.

Coccigrue à lentilles Paulet. Tr. des Champ. 2: 406. pl. 187. f. 7-12. 1793.

Nidularia campanulata With. Bot. Arrang. 3: 445. 1792 [Ed. 2]; Sibth. Fl. Ox. 393. 1794; Fries, Syst. Myc. 2: 298. 1822.

Cyathus Olla Pers. Syn. Meth. Fung. 237. 1801.

Cyathus vernicosus DC. Fl. Fr. 2: 270. 1805; Tul. Ann. Sci. Nat. III. 1: 81. pl. 5. f. 14-23. 1844.

Nidularia plumbea Pers. Champ. Comest. 110. 1818.

Nidularia fascicularis Schwein. Trans. Am. Phil. Soc. 4: 253. 1834.

Cyathus campanulatus Corda, Anleit. lxxx. pl. D. f. 42 (19-23). 1842.

Peridia 8-12 mm. high, 5-15 mm. wide at the top, 2-7 mm. at the base, campanulate, the edge often recurved and expanded; outer surface lightish brown or grayish-yellow, almost smooth, sometimes having a few tow-like fibers attached which give it a slightly roughened appearance; inner surface smooth, whitish or lead-colored, shiny; mouth entire, often ragged and split; sporangioles light-colored, 2-3 mm. in diameter, flattened beneath; spores 8-15 μ long, 6-10 μ wide, thick-walled, hyaline. (Pl. 15. f. 8-13.)

Plants sessile, or sometimes stalked, growing singly or in clusters on the earth, on dry chips, twigs, etc.

NEW YORK: *Underwood*; MAINE: *Harvey, Bartle*; CONNECTICUT: *White*; PENNSYLVANIA: *Martin*; ALABAMA: *Earle*; INDIANA: *Underwood*; KANSAS: *Bartholomew, 1032*; COLORADO: *Ravenel*; UTAH: *Harkness*; CALIFORNIA: *Orcutt, Baker*; TEXAS: *Young*; PUERTO RICO: *Goll*.

11. *Cyathia rufipes* (Ell. & Ev.)

Cyathus rufipes Ell. & Ev. Bull. Torrey Club, **24**: 125. 1897.

Peridia very slender, obconic, .8–1.5 cm. high, 3–6 mm. wide at the top, 1–1.5 mm. at the base, outer surface lightish brown or tow-colored, very shaggy tomentose, and with a quantity of reddish-brown mycelium adhering at the base, forming a felt-like tuft; inner surface smooth, dark gray, shiny; sporangioles 2 mm. in diameter, dark, almost black, shiny, depressed beneath; spores 25–29 μ long, 18–22 μ wide, thick-walled, granular within and hyaline. (*Pl. 15. f. 14–16.*)

On old sods, "growing head downward."

KANSAS: *Bartholomew*; NEBRASKA: *Bates*.

This species is readily distinguished from the other species of *Cyathus* with a smooth inner surface by its very slender elongated shape and its light densely tomentose peridium, besides the characteristic feature of the red felt-like mycelial tuft at the base, from which the species derives its name.

12. *Cyathia Wrightii* (Berk.)

Cyathus Wrightii Berk. Grevillea, **2**: 34. 1873.

Peridia rather large, cup-shaped, 1.2–1.8 cm. high, .5–1.2 cm. wide at the top, contracted somewhat at the base, then bulbous, the bulb composed of mycelium and adhering earth; outer surface darkish brown, very rough, shaggy and encrusted with earth; inner surface smooth, shiny, darkish; mouth entire, not fimbriate though the fine hairs circle up about it; sporangioles dark, 1.5–2 mm. in diameter, shiny, flattened; spores 22–25 μ long, 15–18 μ wide. (*Pl. 16. f. 7–9.*)

CONNECTICUT: Growing singly on earth, *C. Wright*.

This species is not known to have been reported since the original collection. The above description of external characters is based on the cotypes at Harvard University. The spores were

not seen ; the measurement being taken from some mss. notes on *Cyathus* by Masee, made from the type of *C. Wrightii* at Kew. De Toni gives the measurement in Saccardo as "15 μ long by 10 μ wide."

13. ***Cyathia stercorea*** (Schwein.)

Nidularia stercorea Schweinitz, Trans. Am. Phil. Soc. 4 : 253. 1834.

Cyathus Lesueurii Tul. Ann. Sci. Nat. III. 1 : 79. pl. 5. f. 5-13. 1844.

Cyathus Lesueurii, var. *minor* Tul. l. c. 80.

Cyathus stercoreus (Schwein.) De Toni ; Saccardo, Syll. Fung. 7 : 40. 1888.

Peridia slender, campanulate, sessile or with an elongated slender base, .5-1.5 cm. high, 4-8 mm. wide at the top, 1-3 mm. at the base ; outer surface brownish fawn-colored, the young plants being strigose with a copious covering of shaggy hairs, which gradually disappear, leaving the mature peridium almost smooth, or marked with circular depressed zones ; inner surface smooth, shiny, lead-colored, somewhat darker toward the base ; the mouth entire or at first appearing fimbriate from the surrounding hairy covering, but not ciliate-fimbriate ; sporangioles blackish-lead-colored, smooth, shiny, 2 mm. in diameter, depressed beneath ; spores 25-30 μ long, 20-25 μ wide, thick-walled, hyaline, granular within. (Pl. 15. f. 17-20 ; pl. 16. f. 1, 2.)

Growing on manure, bits of wood, etc.

EXSICC. : E. & E. Fungi Columbiani, 644 (as *Cyathus vernicosus*) ; Ravenel, Fungi Amer. Exsic. 473 (as *Cyathus vernicosus*), 474 (as *Cyathus Lesueurii*) ; Ravenel, Fungi Car. Exsic. 3 : 73 (as *Cyathus campanulatus*) ; Ellis, N. A. Fungi, 1308 (*Cyathus vernicosus*) ; Shear, N. Y. Fungi, 316.

PENNSYLVANIA : Schweinitz ; NEW YORK : Underwood, Shear, Brown, Vail ; MASSACHUSETTS : Ellis, Knight ; MAINE : Harvey ; NEW JERSEY : Ellis ; DELAWARE : O. S. ; SOUTH CAROLINA : Ravenel ; VIRGINIA : Murrill ; IOWA : Langlois ; INDIANA : Underwood, Arthur ; OHIO : Morgan, Lloyd ; ALABAMA : F. S. Earle & C. F. Baker, Tuskegee, Carver ; KANSAS : Cragin, 273 ; COLORADO : Baker ; NEBRASKA : Williams ; NEW MEXICO : F. S. Earle & E. S. Earle Cockerell ; CANADA : Dearness, 1149.

This species varies very much as to size, shape and smoothness of the peridium, which facts have been rather misleading, but

such different types have been found in specimens from one locality from the short, strigose, sessile or bulbous form to the slender, almost smooth, elongated form—that there can be no question as to their being in reality but one species. Tulasne does not mention Schweinitz's *Nidularia stercorea*, and his species *Cyathus Lesueurii* from New Orleans was presumably described without knowledge of the preceding species. His variety *Cyathus Lesueurii* var. *minor* from Carolina, closely resembles small forms of *Cyathia stercorea*.

CYATHIA (?) sp.

Peridia cup-shaped, clustered, 4–6 mm. high, 3–5 mm. wide at the top, 2 mm. at the base; outer surface lightish brown, nearly smooth, or minutely fibrous; inner surface smooth, very dark brown, almost black, shiny; mouth entire or slightly ragged, but not fimbriate; sporangioles black, shiny, angular beneath, rounded above, 1 mm. in diameter, showing no trace of any attachment, numerous; spores 20–30 μ long, 18–24 μ wide, thick-walled, granular within, hyaline. (*Pl. 16. f. 16, 21, 22.*)

No mention as to habitat.

The specimens on which the above description is based were sent to Mr. Ellis by Professor E. Bethel (no. 9) from Denver, Colorado, and were named *Cyathus vernicosus*. They consist of four or five groups of from two to five plants in each. The peridial wall is triple and the structure of the sporangioles is much as in *Cyathia*, the spores being also intermixed with thick horny filaments as in that genus; but there is no trace whatever of any attachment either on the under surface of the sporangioles or on the inner surface of the peridium. The specimens are all mature, so it is impossible to know what the nature of the young peridia was, but the sporangioles are still in the peridia, filling them completely, even with the margin quite unlike anything seen belonging to the genus *Cyathia*. It is very possible that a genus standing in the same relation to *Cyathia*, as *Nidula* does to *Crucibulum*, will eventually have to be established to accommodate these forms, but the material and data are not sufficient to justify taking such a step at present.

SPECIES INQUIRENDA

CYATHUS NIVEO-TOMENTOSUS P. Henn. Hedwigia, 37: 274. 1898

Sparsis: peridio obconico-cyathiformi, crassiusculo papyraceo primo operculo albo tecto, sessili vel substipitato, extus niveo

sericeo, dense tomentoso, margine integro, crasso, 3–5 mm. alto, 4–5 mm. lato, intus albo-flavescente; sporangiolis innumeris, lentiformibus, planis, tenue tunicatis, cinnamomeis, sericeis, 1–1.2 mm. diametro; sporis ellipsoideis, obtusis, intus granulatis, hyalinis, 7–8.5 × 4.5–5.5 μ , episporio hyalino, tenui, levi.

CALIFORNIA: Potter Valley. On decaying wood (Sept. 1894). *Purpus*.

The original description is quoted, as no specimens of this species were seen, and until more material has been collected it is difficult to decide with any degree of certainty just where it belongs. The author adds that this species appears to be related to *Cyathia pallida*.

II. CRUCIBULUM Tul. Ann. Sci. Nat. III. 1: 89. 1844

Peridium composed of a single, homogeneous, though sometimes layered, felt-like membrane, which is at first continuous over the mouth, forming a sort of epiphragm; sporangioles more numerous than in the preceding genus, and the funiculus is much less complex, consisting of a little bundle of elastic filaments gathered closely together in a very thin, hardly noticeable outer covering, the upper end of which is attached to a nipple-like protuberance on the under surface of the sporangiole, and the lower end is attached to the inner wall of the peridium; there are no filaments intermixed with the spores.

Although the genus *Crucibulum* was not founded until 1844, for nearly a century and a half plants belonging to it have been known and unmistakably figured. Ray* in 1696, in a list of plants collected by D. Samuel Doody, mentions "Fungus seminifer minor," which he figured in 1724.† Micheli, five years later, gave a good figure of *Crucibulum crucibuliforme*. As early as 1697 Boccone‡ figured this plant, under the name of "Fungus $\sigma\pi\epsilon\rho\mu\alpha\tau\iota\alpha\varsigma$ calyculatus," but does not seem to give it more than this passing notice. Gleditsch,§ Schaeffer,|| Scopoli,¶ Hudson,** Hoffman†† and others made mention of this plant, under various names, but

* Syn. 333. 1696. [Ed. 2.]

† Ray, Syn. 20. *pl. 1. f. 2 b, c.* 1724. [Ed. 3.]

‡ Mus. Fis. *pl. 301. f. 1.* 1697.

§, Meth. Fung. 138. *pl. 4.* 1753.

|| Fung. Bav. et Palat. Icon. 2: *pl. 179.* 1761; 4: 125. 1774.

¶ Flor. Carn. 2: 486. 1772. [Ed. 2.]

** Flor. Ang. 2: 634. 1778. [Ed. 2.]

†† Veget. Crypt. fasc. 2: 29. *pl. 8. f. 1.* 1790.

not until 1801, was the present generic name employed by Persoon *—even then only to denote a species—*Cyathus Crucibulum*.

Schweinitz was the first to report *Crucibulum crucibuliforme* from this country under the name of *Nidularia Crucibulum*. He also described another species, *Nidularia juglandicola* which though retained as a good species of *Crucibulum* by De Toni,† proves to be a form of *Crucibulum crucibuliforme*, slightly larger and more flaring, but otherwise similar to the type species. Though the genus as represented by *Crucibulum crucibuliforme* is comparatively common and widely distributed, it is interesting to note in contrast with the genus *Cyathia*, which is very prolific of species, that only one other species has been described, viz., *Crucibulum simile* Massee‡ from New Zealand and Australia, and even this is said to resemble *Crucibulum crucibuliforme* closely.

Bulliard§ says that there are two varieties of *Crucibulum* both of which he figures, one glabrous, almost as smooth inside as out, the other smooth inside but somewhat tomentose on the outside, and always larger and more yellow than the first. It has been noticed in examining quite a number of specimens from different localities that those collected in one place often vary greatly in size and color, and in the nature of the tomentose outer surface of the peridium. Cooke,|| in 1879, described a variety which he calls *lanosum*, and which De Toni says might possibly be Bulliard's second variety (figured on *pl. 40*) but as Cooke described it as "paler than in the usual form" this disposition cannot be correct.

1. *Crucibulum crucibuliforme* (Scop.)

Peziza sessilis campanulata (b) Gled. Meth. Fung. 138. *pl. 4.* 1753.

Peziza secunda Schaeff. Fung. Bav. et. Palat. Icon. 2: *pl. 179.* 1763.

Peziza lentifera Oeder, Fl. Dan. 2: 9. *pl. 105.* 1763; not Linnaeus.

Peziza crucibuliformis Scop. Flor. Carn. 2: 486. 1772 [Ed. 2]; Schaeff. Fung. Bav. et Palat. 4: 125. 1774.

* Syn. Meth. Fung. 239. 1801.

† Saccardo, Syll. Fung. 7: 44. 1888.

‡ Grevillea, 19: 93. 1891.

§ Champ. 1: 165. *pl. 40* and *pl. 438.* 1809.

|| Grevillea, 8: 58. 1879.

Peziza laevis Huds. Fl. Ang. 634. 1778. [Ed. 2.]

Cyathus cylindricus Willd. Fl. Berol. 399. 1787.

Cyathus crucibuliformis Hoffm. Veg. Crypt. fasc. 2, 29. pl. 8. f. 1. 1790.

Nidularia laevis Bull. Champ. 1: 164. pl. 448. f. 2. pl. 40. 1791; With. Bot. Arrang. 3: 446. 1792 [Ed. 2]; Sibth. Fl. Ox. 393. 1794.

Cyathus Crucibulum Pers. Syn. Fung. 238. 1801; Nees, Syst. 140. pl. 13. f. 133. 1817.

Cyathus laevis DC. Fl. Fr. 2: 269. 1805.

Nidularia Crucibulum Secret. Mycogr. Suisse, 3: 378. 1833; Schwein. Trans. Am. Phil. Soc. 4: 253. 1834.

Nidularia juglandicola Schwein. Trans. Am. Phil. Soc. 4: 253. 1834.

Crucibulum vulgare Tul. Ann. Sci. Nat. III. 1: 90. pl. 6. f. 9-24. pl. 7. f. 1. pl. 8. f. 13-17. 1844.

Crucibulum juglandicolum De Toni; Sacc. Syll. Fung. 7: 44. 1888.

Peridia 5-10 mm. high, 5-10 mm. across at the top, 4-7 mm. at the base, cylindrical-campanulate, base truncate or but slightly contracted; outer surface dirty cinnamon or grayish fawn-color, young plant minutely velvety tomentose, becoming smoother with age; the inner surface smooth, shiny and whitish; mouth entire, firm and even, sometimes slightly contracted, sporangioles pale ochraceous, becoming whitish, 1.5-2 mm. in diameter, very numerous and crowded, flattened beneath; spores hyaline, elliptic, 8-10 μ long, 4-6 μ wide, smooth, some thick-walled. (Pl. 16. f. 10-15; pl. 18. f. 7-13 and 16.)

Plants gregarious or single on twigs, old bagging, chips, etc.; common and variable.

EXSIC.: Ellis, N. A. Fungi, no. 728; Ravenel, Fungi Amer. Exsic. no. 139.

NEW YORK: *Underwood*, *Clinton*, *Jelliffe*; MAINE: *Harvey*; CONNECTICUT: *Underwood*, *White*; MASSACHUSETTS: *Underwood*, *Underwood & Seymour*, 941; NEW JERSEY: *Ellis*, *White*; PENNSYLVANIA: *Haines*, *Everhart*; ALABAMA: *Underwood*, *Earle*; VIRGINIA: *Underwood*; KENTUCKY: *Underwood*; INDIANA, *Underwood*; KANSAS: *Cragin*, 490; OREGON: *Carpenter*; MONTANA: *Reynolds*; COLORADO: *Bethel*, *Underwood & Selby*; WASHINGTON: *Suksdorf*.

The following is extracted and translated from Tulasne's more extended description of this species: The inner white evanescent pellicle is a remnant of the mucilaginous matter which fills the cup in its early stages. The sporangioles are accumulated in large numbers in a space apparently too small to contain them. They are covered with a thick fibrous coat which can be peeled off, and when deprived of this the sporangiole is black and of a horny consistency. It is composed of two parts, a thick and much interwoven darker outer part, and an inner hyaline portion composed of irregularly shaped filaments taking the place of basidia and forming a hymenium of which the surface is nearly uniform. The rest of the inner substance is composed of the spores without any filaments, which fact distinguishes these sporangioles from some of those belonging to species of *Cyathia*. The funiculus of *Crucibulum* is much more simple than that of *Cyathia hirsuta*, being composed of a little bunch of elastic filaments gathered closely together in a very thin, transparent outer covering, which is hardly noticeable, and of an equal flet, about 2-3 mm. long, which expands itself at the base into the inner wall of the peridium.

III. *Nidula* gen. nov.

Peridium composed of a single homogeneous, but layered membrane which is at first continuous over the mouth much as in *Crucibulum*; sporangioles very numerous, at first immersed in a glutinous substance, very closely packed, entirely filling the central cavity and in no way attached to the peridium wall; no filaments intermixed with the spores.

Peridium shaggy-tomentose; sporangioles light-colored, 2 mm. wide.

1. *N. candida*.

Peridium minutely tomentose; sporangioles dark-colored, barely 1 mm. wide.

2. *N. microcarpa*.

1. *Nidula candida* (Peck)

Nidularia candida Peck, Reg. Rep. 45: 24. 1891.

Peridia 6-15 mm. high, 6-15 mm. wide at the top, 5-10 mm. at the base, cylindrically cup-shaped, somewhat truncate at the base; outer surface white, becoming dingy with age, thick, felt-like, shaggy-tomentose; inner surface smooth, at first snowy white, becoming brownish with age, somewhat shiny; mouth entire, firm, somewhat spreading but not recurved; sporangioles 1.5-2 mm. in diameter, light grayish fawn-colored, very thin, flattened, both sur-

faces perfectly even, angular, but not depressed; spores 6–10 μ long, 4–8 μ wide, globose to elliptic, hyaline, somewhat granular, thin-walled. (*Pl. 16. f. 17–20.*)

Growing singly on twigs, moss, etc.

WASHINGTON: Olympia, *Henderson, Suksdorf.*

BRITISH COLUMBIA: *Macoun, 107.*

2. *Nidula microcarpa* Peck, sp. nov.

Peridia 4–6 mm. high, 4–5 mm. wide at the top, 3–5 at the base, subcylindrical; outer surface whitish, or pale grayish-yellow, minutely tomentose, firm; inner surface smooth, with a thin brownish shiny layer formed by the drying of the glutinous inner substance; mouth entire, straight and firm; sporangioles very numerous, lenticular, covered with a thick fibrous outer coat, which peels off, as in *Crucibulum crucibuliforme*, when dry rugosely wrinkled, becoming smooth when moistened, reddish-brown, .5–1 mm. wide; spores 6–9 μ long, 4–6 μ wide, broadly elliptic or subglobose, hyaline, thick-walled. (*Pl. 17. f. 1–6; pl. 18. f. 14, 15, 17.*)

Growing on wood, and on the ground.

CALIFORNIA: *W. R. Dudley.*

MONTANA: Columbia Falls, *R. S. Williams.*

2a. *NIDULA MICROCARPA rugispora* var. nov.

Crucibulum rugisporum E. & E. in herb.

Peridia 3–5 mm. high, 3–6 mm. wide at the top; outer surface yellowish-white, with a rather thin close tomentum; inner surface smooth, whitish or brownish, somewhat shiny; mouth recurved, and spreading, and minutely lacerate, fimbriate; sporangioles very numerous, reddish-brown, rugose when dry, barely 1 mm. wide, flattened, subrotund; spores broadly elliptic, hyaline, slightly thick-walled, 6–9 μ long, 4–7 μ wide, slightly larger than in the foregoing species. (*Pl. 17. f. 7–9.*)

Growing on dead twigs.

WASHINGTON: Skamania county, alt. 3,000 ft., *Suksdorf, 510.*

Though this variety closely resembles the species it differs in the mouth characters and in the somewhat larger spores.

IV. GRANULARIA Roth, Ust. Ann. Bot. 1: 6. *pl. 1. f. 1.* 1791

Nidularia Fries & Nord. Symb. Gaster. 2. 1817–18.

Peridium composed of a single homogeneous rather thin closed membrane, or a thin, closely interwoven layer of branched fila-

ments, opening more or less irregularly by the breaking away or falling to pieces of the walls at maturity, having no true epiphragm : sporangioles enveloped in mucus and not attached in any way to the inner surface of the peridium.

The history of the genus *Granularia*, though not as long as that of the first two genera belonging to this family, appears to have become more involved and complicated, very probably owing to the fact that the species of *Granularia* are as a rule, rarer, and less conspicuous than the species of *Cyathia* and *Crucibulum*. Micheli * in 1729 figured "*Cyathoides scutellatum*," which is unquestionably a true *Granularia*, and the reason why this species has since been placed under *Cyathus* by Roth † and later by Tulasne, it hard to understand. Micheli, in writing of this genus, says "[fructus] vel prope centrum, vel ad circumferentiam brevissimo pediculo seu umbilicali funiculo firmantur," but of the figure of three sporangioles of "*Cyathoides scutellatum*" only one has a short lateral attachment, and that much shorter than in the figures of the sporangioles of the three other species represented. Fries ‡ says of his second division, which contains true *Granularia*, that the sporangioles have no umbilicus or umbilical thread, but are attached by the margin. Tulasne writes that notwithstanding these authorities, the lateral position of a funiculus seems very problematical in the genus *Cyathia*, and that the sporangioles of the specimens of *Granularia* which he has studied do not adhere any more by the edge than by any other point, either to the mucilage in which they are immersed or to the peridium. This idea must have arisen from the fact that the mucus contiguous to the walls of the peridium dries up a little quicker than that in the center of the cup and for this reason, several sporangioles appear to be fixed by their outer margin, while they are still loose in the center of the cup. But this does not explain why "*scutellaris*" has been made a species of *Cyathia*.

No other writer seems to have mentioned this plant after Micheli until 1791, when Roth described a new genus *Granularia*, as follows : "Fungus subrotundus, granis mucilagine immersis

* Nov. Pl. Gen. 222. pl. 102. f. 4. 1729.

† Roth, Cat. Bot. 1 : 237. 1797.

‡ Syst. Myc. 2 : 300. 1822.

farctus," with one species *Granularia pisiformis*, which he fully describes and figures. This is unquestionably a *Nidularia*, as this genus was called until Otto Kuntze restored *Granularia* to its proper place in 1891. Roth* himself described and figured two species six years later under the name of *Cyathus farctus*, and *Cyathus scutellaris*; it is possible that these belong to our genus *Nidula*, but with the imperfect descriptions it is difficult to determine. It is very evident that they are not species of *Cyathia*.

Bulliard,† in 1780 made the first mention of the name *Nidularia*, but he referred it to figures which have been unquestionably proved to be *Cyathia lentifera* and *Crucibulum crucibuliforme*. Sibthorp‡ also employed this name for *Cyathia lentifera*, *Cyathia hirsuta* and *Crucibulum crucibuliforme*. In 1817 Nees§ described and figured *Nidularia granulifera*, but although he gives a colored plate, it is difficult to form a correct idea of his plant. Two years later Ehrenberg|| described and figured *Nidularia globosa* which he says resembles *Cyathus farctus* Roth and *Cyathus deformis* Willd.¶ but agrees with neither. About this time, 1818, Schweinitz described from North Carolina *Cvathus pulvinatus*, which, though unfortunately none of the original material remains except some of the wood on which it grew, is evidently a true *Granularia* and is a fairly common species in our own country, and the only clear and definite one of the whole tangled thread of the present history.

The family Nidulariaceae was established by Fries in 1822. Under the section "*Nidularia*," he gives seven species, five of which are the above-quoted ones of Nees, Schweinitz, Roth, Ehrenberg and Willdenow; the last one, *Nidularia denudata* Fr. & Nordh.** appears from the description to be a true *Granularia*, while the third species which he gives as *Nidularia farcta* he refers to Ray's †† no. 21, which is the first mention of *Crucibulum crucibuliforme*.

* Cat. Bot. 1 : 237. pl. 7. f. 2. 1797.

† Herb. Fr. pl. 488.

‡ Flor. Ox. 393. 1794.

§ Syst. Pilze. 139 note. pl. 13. f. 133c. 1817.

|| Sylv. Myc. Berol. 16, 28. f. 8. 1819.

¶ Ust. Bot. Mag. 2 : 14. pl. 5. f. 8. 1788.

** Symb. Gaster. 4. 1817-18.

†† Syn. 20. pl. 1. f. 2.

Fischer * in writing of *Nidularia* says that there are sixteen known species, but though De Toni † gives eighteen from all parts of the world, it is more than probable that several of these are either synonyms of other species or belong to other genera. Tulasne gives eleven species, to nine of which he adds "non vidimus"! the remaining two being new species—*Nidularia australis* from Chili, South America, and *Nidularia Duriacana* from LaCalle, Algeria (Mauritania). From America several additional species have been described, namely, *Nidularia Alabamensis* Atk. ‡ from Alabama, which we have reduced to *Granularia pulvinata*, and *Nidularia rubella* E. & E. § from New Jersey. This last species is very uncertain, in fact it may not belong to this family at all, as the sporangioles are quite different in texture from those of all the other species, and have never been found to contain any spores, being filled with small pieces of amorphous hyaline matter. It is hard to believe that the plants are in an immature condition as the peridial walls have in some specimens almost entirely disappeared. The only remaining species of *Nidularia* which has been described in this country is *Nidularia candida* Peck which has been referred to the preceding genus. Two heretofore unpublished species of *Granularia* complete our present list: *Granularia castanea*, a herbarium species of Ellis & Everhart, under the name of *Nidularia castanea*, from New Jersey found in 1883, and *Granularia rudis* Peck, from California.

Synopsis of the Species of *Granularia*

Sporangioles numerous, small (1 mm. or less in diameter).

Peridium tubercular, pulverulent. 1. *G. pulvinata*.

Peridium only slightly tubercular, not pulverulent. 2. *G. castanea*.

Sporangioles few, larger (2 mm. or more in diameter). 3. *G. rudis*.

1. GRANULARIA PULVINATA (Schwein.) Kuntze, Rev. Gen. Pl.

2 : 855. 1891

Cyathus pulvinatus Schwein. Fung. Car. Sup. 51. 1818.

Nidularia pulvinata Fries, Syst. Myc. 2 : 301. 1822 ; Schwein.

Trans. Am. Phil. Soc. 4 : 253. 1834.

* Engler & Prantl. Nat. Pflanzenfam. 11** : 326. 1899.

† Saccardo. Syll. Fung. 7 : 28. 1888 ;—9 : 265. 1891 ;—11 : 156. 1895 ;—14 : 256. 1899.

‡ Bull. Cornell Univ. (Science) 3 : 23. 1897.

§ Bull. Torrey Club, 11 : 18. 1884.

Nidularia Alabamensis Atk. Bull. Cornell Univ. (Science) 3: 23. 1897.

Peridia subspherical, sessile, 2–10 mm. wide, 2–9 mm. high, reddish-brown or dirty cinnamon-colored, at first very floccose-pulverulent, gradually becoming smoother with age, dehiscing irregularly or not at all; peridium thin and rather brittle, tuberculose; inner surface is shiny, smooth, brownish; sporangioles very numerous, darkish brown, barely 1 mm. in diameter, somewhat angular and depressed; spores hyaline, thick-walled, 6–10 μ long, 4–7 μ wide. (*Pl. 17. f. 10–16, 20; Pl. 18. f. 19.*)

Plants gregarious, rarely singly on wood.

NEW YORK: *Ellis, Fairman, Kupfer*; LOUISIANA: *Langlois*, 2666 and 1821; CONNECTICUT: *White*; MAINE: *Harvey*; ALABAMA: Auburn, *Atkinson*.

The floccose pulverulent appearance of the surface of the peridium is caused by the innumerable ends of the filaments which compose the peridium protruding above the main structure, soon becoming broken or eroded. This is a very characteristic feature which renders this species easily recognizable.

Atkinson (*l. c.*) describes *Nidularia Alabamensis*, which undoubtedly belongs here substantially as follows: Peridia spherical, sessile, reddish-brown, roughened, 4–5 mm. in diameter, irregularly dehiscing by the breaking into fragments of the upper portion exposing the sporangioles which completely fill it; no "rooting" threads; sporangioles lenticular, shiny, dark or blackish-brown, barely 1 mm. in diameter, corrugated, hard, filled with a whitish pulpy material which is composed of stout irregular flexuous or blanched knotty strongly tuberculose threads with which the spores are mixed; the spores are obovately hyaline, 4–6 \times 3–4 μ .

On decaying wood.

ALABAMA: Auburn, July, 1890.

2. *Granularia castanea* (Ell. & Ev.) sp. nov.

Nidularia castanea Ellis & Everhart in herb.

Peridia small, elongate-globose, or subspherical, sessile, sometimes confluent, .5–2 mm. long, 0.5–1 mm. high; peridial walls very thin, and brittle at first, pale yellowish fawn-colored, gradually as the plant matures becoming grayish, and somewhat tuberculose from the inner pressure of the sporangioles, dehiscing irregularly, the outer covering often breaking away completely,

leaving the sporangioles seated alone on the wood, barely visible without magnification; sporangioles yellowish-brown, very numerous, crowded, circular, flattened above and below, barely 0.25 mm. in diameter, even or slightly creased under high magnification; spores subglobose, hyaline, thick-walled, 4-7 μ long, 3-6 μ wide. (*Pl. 17. f. 17-19; pl. 18. f. 20.*)

Gregarious on wood.

NEW JERSEY: Newfield, July, 1883. *Ellis.*

3. *Granularia rudis* Peck sp. nov.

Peridia hemispherical or subglobose, sessile; outer covering thin, smooth, fragile when dry, cellular, rather gelatinous when moist, yellowish-brown with a faint greenish tint; indehiscent or the peridial walls gradually breaking away; sporangioles few, irregular, angular or compressed, 2-2.3 mm. in diameter, blackish or greenish tinted; spores broadly elliptic or subglobose, hyaline, 7-9 μ long, 6-8 μ broad. (*Pl. 17. f. 21-23.*)

On decaying wood.

CALIFORNIA: *W. R. Dudley.*

The material from which this species is described is very scanty, but the specific features are so individual, and they differ so much from any known species of *Granularia* that it has been decided to include it in the present revision. It differs from all known species in the gelatinous cellular and greenish texture of the peridium, and in the large angular sporangioles, only a few being contained in each peridium.

SPECIES INQUIRENDA

NIDULARIA RUBELLA Ell. & Everh. Bull. Torrey Club, 11: 18. 1884.

The following table will show the present known distribution of the family in North America:

Explanation of Plates

The figures on Plates 14, 15, 16 and 17 were drawn one quarter larger than indicated. Those on Plate 18 were made twice the size. The microscopic details were drawn with a camera lucida and reduced on the same scale, as above noted.

PLATE 14

FIG. 1. *Cyathia Poeppigii*, nat. size. 2. The same, enlarged about three times after moistening. 3. Single peridium in dry condition. 4. Spores, $\times 335$. 5. *Cyathia Berkleyana*, nat. size. 6. Peridium of same, enlarged three times. 7. Spores, $\times 335$. 8. *Cyathia intermedia*, nat. size. 9. Peridia, enlarged twice, one in dry condition, the other after expanding when moistened. 10. Spores, $\times 335$. 11. *Cyathia hirsuta* nat. size. 12. Group, enlarged about three times. 13. Spores, $\times 335$. 14, 15. *Cyathia hirsuta infundibuliformis*, enlarged about three times. 16. *Cyathia dura*, nat. size. 17, 18. Peridia, enlarged twice. 19. Spores, $\times 335$. 20. *Cyathia Montagnei*, nat. size. 21. Peridium, enlarged twice. 22. Spores, $\times 335$.

PLATE 15

FIG. 1. *Cyathia melanosperma*, nat. size. 2. Single peridium, nat. size (after moistening). 3. Single peridium, enlarged about three times. 4. Spores, $\times 335$. 5. *Cyathia pallida*, nat. size. 6. Mature and young peridia, enlarged twice. 7. Spores, $\times 335$. 8. *Cyathia lentifera*, nat. size. 9, 10, 11, 12. Different specimens showing character of growth and shape, enlarged twice. 13. Spores, $\times 335$. 14. *Cyathia rufipes*, nat. size. 15. Peridia, enlarged twice. 16. Spores, $\times 335$. 17. *Cyathia stercorea*, nat. size. 18, 19. Different specimens showing character of growth and shape, enlarged about three times. 20. Spores, $\times 335$.

PLATE 16

FIGS. 1, 2. *Cyathia stercorea*, showing additional types and characteristics, enlarged twice. 3. *Cyathia rugisperma*, natural size. 4. Peridia enlarged twice. 5. Spores, $\times 335$. 6. Spores, $\times 585$. 7. *Cyathia Wrightii*, natural size. 8, 9. Peridia, enlarged twice. 10. *Crucibulum crucibuliforme*, natural size. 11. Section of sporangiole, $\times 50$. 12. Group of peridia, enlarged twice. 13. Spores, $\times 335$. 14. Group of peridia from the Schweinitz specimens of *Crucibulum juglandicolum*. 15. Spores from the same, $\times 335$. 16. *Cyathia* (?) sp., natural size. 17. *Nidula candida*, natural size. 18, 19. Peridia, somewhat enlarged. 20. Spores and filament, $\times 335$. 21, 22. Spores of *Cyathia* (?) sp., $\times 335$.

PLATE 17

FIG. 1. *Nidula microcarpa*, nat. size. 2. Peridia, enlarged twice. 3. Section-enlarged about five times. 4. Sporangiole showing torn outer covering, enlarged about twenty-five times. 5. Sporangiole still in its outer covering, enlarged twelve times. 6. Spores, $\times 335$. 7. *Nidula microcarpa rugispora*, nat. size. 8. Peridium, enlarged three times. 9. Spores, $\times 335$. 10. *Granularia pulvinata*, nat. size, reduced from drawing by Mr. Hasselbring of *Nidularia Alabamensis* Atk. 11. *Granularia pulvinata*, nat. size. 12. Peridia, enlarged three times. 13. Spores and filaments, $\times 335$. 14. Very old peridia, the walls of which have almost completely fallen away. 15. Spores. $\times 585$. 16. Spores, $\times 335$. 17. *Granularia castanea*, nat. size. 18. Group of peridia, enlarged twice. 19. Irregular peridia, having grown together, enlarged twice. 20. Spores of *Granularia pulvinata*, $\times 335$ (*Nidularia Alabamensis* Atk.). 21. *Granularia rudis*, enlarged twice. 22. Spores, $\times 335$. 23. Sporangioles, $\times 15$.

PLATE 18

FIGS. 1-6. *Cyathia hirsuta*. 1. Sporangiole, showing attachment, enlarged about fifteen times. 2. Spore, $\times 390$. 3. Spores and filaments, $\times 215$. 4. Threads of outer coating of sporangiole, $\times 215$. 5. Nodose filaments of the funiculus, $\times 390$. 6. Portion of the funiculus, $\times 110$. 7-13. *Crucibulum crucibuliforme*. 7. Sporangiole, $\times 15$. 8. Sporangiole, with the outer coat peeling off. 9. Small portion of a section of a sporangiole, $\times 215$. 10, 11. Spores of young specimen, $\times 390$. 12. Spores of fully mature specimen, showing contraction of inner substance, $\times 390$. 13. Small portion of the ends of the filaments of the thin membrane covering the mouth of the immature specimen, $\times 315$. 14. Spores of *Nidula microcarpa*, $\times 390$. 15. Lateral portion of outer coat of the sporangioles of same, $\times 215$. 16. Small portion of the outer coat of the sporangiole of *Crucibulum crucibuliforme*, $\times 215$. 17. Section of a sporangiole of *Nidula microcarpa*, $\times 110$. 18. Fascicular hairs from the outer covering of the peridium of *Cyathia intermedia*, $\times 15$. 19. Small portion of the peridial wall of *Granularia pulvinata*, $\times 215$. 20. Sporangioles of *Granularia castanea*, when devoid of peridial covering, $\times 110$.